



INFRASTRUCTURE DEVELOPMENT

Infrastructure provides connection. All infrastructure, whether physical or digital, functions to connect people with people, goods, information, places, markets, or resources. Access to roads, the internet, power lines, and waterpipes connect people to the things that they need to live, not just what they want. After decades of underfunding, infrastructure investment must accelerate to meet these needs, made more urgent by the effects of climate change. And when investment addresses need, opportunities from a portfolio perspective are likely to emerge.

KEY TAKEAWAYS

- Infrastructure investment is severely underfunded and requires a significant global push to close the \$15 trillion investment gap by 2040.¹
- The transition to a more sustainable future with climate change more acute and energy security a priority accelerated the demand for green infrastructure, particularly clean energy.
- The Infrastructure Development theme connects numerous rapidly growing mega themes, including Connectivity, New Consumer, and Mobility, which offer compelling investment potential.

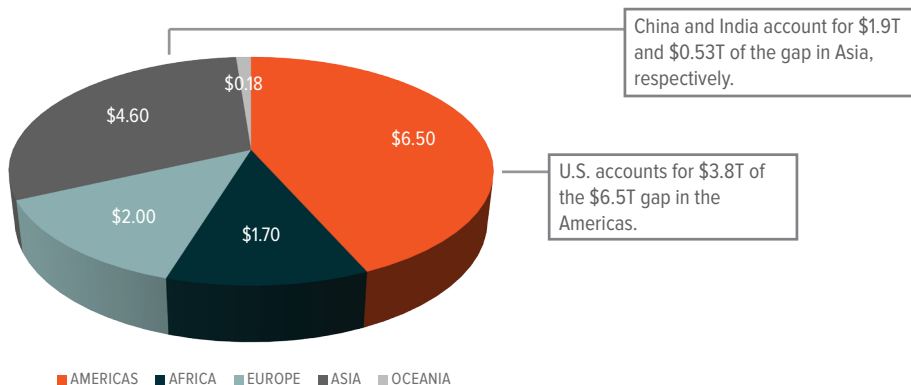
WHY INFRASTRUCTURE DEVELOPMENT IS SUCH A POWERFUL FORCE

A \$15 trillion infrastructure gap by 2040 creates an urgent need for investment.

Governments across the globe have mobilized to close the infrastructure gap with various funding programs. We expect investments in infrastructure will continue to grow, creating tailwinds for the Infrastructure Development theme and beyond. The opportunity varies across the globe, but the largest investment gaps are in the Americas and Asia. As the chart below shows, the investment gap in the Americas is the largest at \$6.5 trillion.

INFRASTRUCTURE SPENDING GAP (TRILLION)

Source: Global Infrastructure Hub, 2021

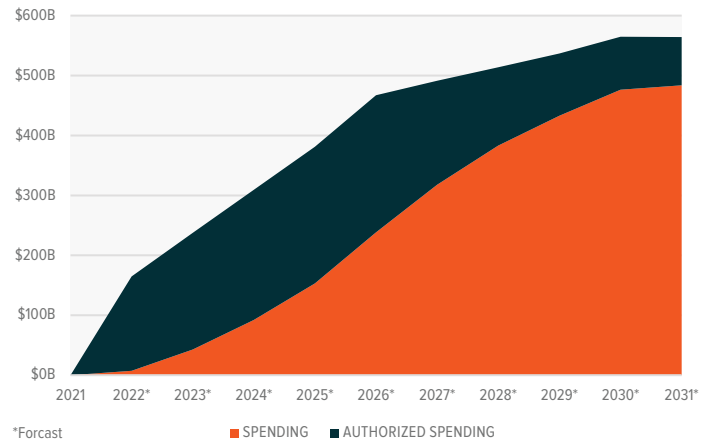


The U.S. accounts for nearly 60% of the total gap and has the greatest investment need in the Americas. Much of the shortfall in the U.S. is attributed to the expansive nature of the country combined with the cumulative lack of investment. Airports, ports, roads, and bridges require significant enhancements. The American Society of Civil Engineers grades U.S. roads a “D,” bridges a “C,” airports a “D+,” and ports a “B-,” noting that the U.S. is “badly in need of greater investment in infrastructure.”²

The U.S. took a major step toward enhancing its infrastructure with the \$1.2 trillion Infrastructure Investment and Jobs Act (IIJA) in November 2021. The IIJA will direct \$550 billion over the next 10 years to rebuild roads, bridges, airports, and rails, expand access to clean drinking water and broadband internet, and advance environmental justice.³ Congressional Budget Office (CBO) forecasts suggest the federal government will disburse 51% of authorized IIJA funding by 2026 and 86% by 2031. In 2023, infrastructure spending is likely to accelerate as federal agencies build out logistical frameworks for new infrastructure programs, streamline approval processes, and engage with states on competitive grants.

INFRASTRUCTURE INVESTMENT & JOBS ACT IMPLEMENTATION LIKELY TO ACCELERATE IN COMING YEARS

Source: Congressional Budget Office, 2021



Asia has the second largest investment gap at \$4.6 trillion, with China and India making up half the gap. China has spent a trillion dollars through its Belt and Road Initiative (BRI). The project intends to build railways, ports, roads, dams, pipelines, and industrial corridors across dozens of countries in Asia, Europe, and Africa. The global economic slowdown forced Chinese banks to sharply reduce lending for new projects as they focus on cleaning up their existing loan portfolios.⁴ It will be important to monitor the BRI’s progress, given its significance to infrastructure development across China and developing nations. In 2019, India committed to spending \$1.5 trillion over the next 5 years toward infrastructure, including rail, roads, and waterway connectivity.⁵

Europe is responsible for \$2.0 trillion of the investment gap.⁶ In 2022, the European Union (EU) committed to invest €5.4 billion to support post-pandemic economic recovery in all EU Member States while contributing to the construction of missing transport links and other infrastructure projects across the continent.⁷ Investments at the individual country level includes Germany’s plan to invest about \$55 billion in the development of quantum computing, artificial intelligence, offshore wind, hydrogen energy, and electric vehicles. Italy recently announced a plan to invest 3.9 billion euro to improve water infrastructure and reduced leaks in cities and agriculture areas.⁸



Energy infrastructure is now a priority after years of underfunding.

Energy infrastructure can be broken down to three components: generation, transmission, and distribution. The U.S. national grid is aging, with components over a century old, far past their 50-year life expectancy. To meet the latest state-driven Renewable Portfolio Standards, the country's energy infrastructure gap is projected to grow to \$197 billion by 2029.⁹ Globally, the energy investment need totals \$34.9 trillion and the gap \$2.92 trillion through 2040.¹⁰

Despite the large gap, spending has increased significantly over the past decade. In the U.S., annual spending on high voltage transmission lines grew from \$15.6 billion in 2012 to \$21.9 billion in 2017, while annual spending on distribution systems—the “last mile” of the electricity network—increased 54% over the past two decades.¹¹ Government funding from the IIJA will direct \$73 billion toward power infrastructure and clean energy, including the deployment of smart grid technologies and battery storage, green hydrogen, carbon capture technology, and renewable power.¹² Utilities are strengthening the electric grid through resilience measures.¹³

Weather is an increasing threat with climate change exacerbating the frequency and intensity of severe weather events and their associated costs. Severe weather was the predominant cause of the 638 reported transmission outages reported from 2014 to 2018. Another issue is distribution infrastructure's struggles with reliability, with 92% of all outages occurring along this segment resulting from a range of issues including aging infrastructure, weather events and vandalism. In the coming years, additional transmission and distribution infrastructure, smart planning, and improved reliability are needed to accommodate the changing energy landscape as delivery becomes distributed and renewables grow.¹⁴

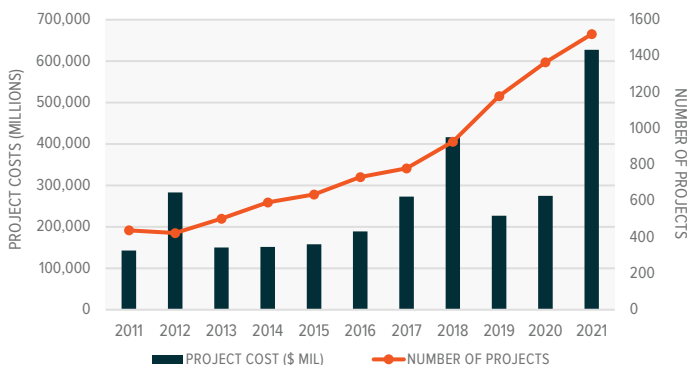
Renewables' share of generating capacity is expected to accelerate as the world progresses toward net zero emissions. Electricity generation from renewable energy sources in the U.S. rose from 18% in 2019 to 25% during the first half of 2022, with about 50% of the generation coming from wind and 30% from hydropower.¹⁵ In *Climate Change*, we highlight the key segments within renewable energy that can benefit from the transition to cleaner energy.

Greening Infrastructure

Infrastructure is responsible for more than 60% of global greenhouse gas emissions, so it's no wonder why a vast majority of today's infrastructure investment focuses on sustainability.¹⁶ As the chart below shows, in 2021, a record US\$627 billion in sustainable infrastructure projects were announced in the renewable energy and nuclear sectors across categories including wind, solar, nuclear, and clean waste. That total includes 1,521 individual projects in the Americas, Asia-Pacific, Europe, and Japan, more than 3.5x the total number of sustainable infrastructure projects launched a decade earlier and more than 4x the total dollar value.¹⁷

SURGE IN SUSTAINABLE INFRASTRUCTURE PROJECTS

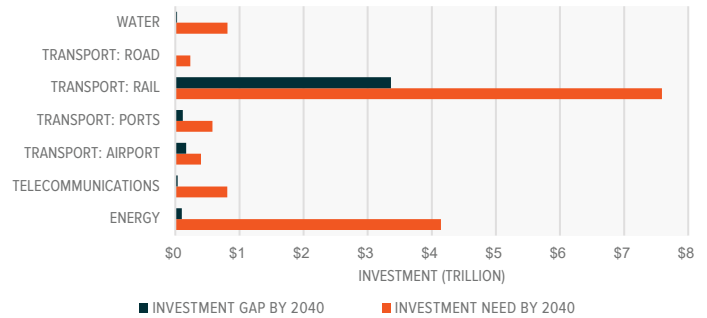
Source: Refinitiv Infrastructure 360 data as of December 31, 2021



VISUALIZING THE MARKET OPPORTUNITY

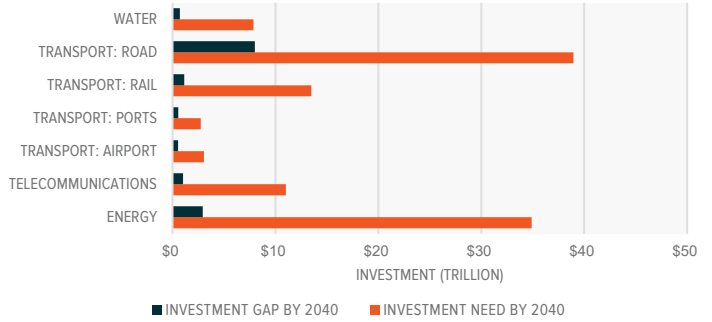
U.S. INFRASTRUCTURE INVESTMENT BY SECTOR

Source: Global Infrastructure Hub data as of December 31, 2021



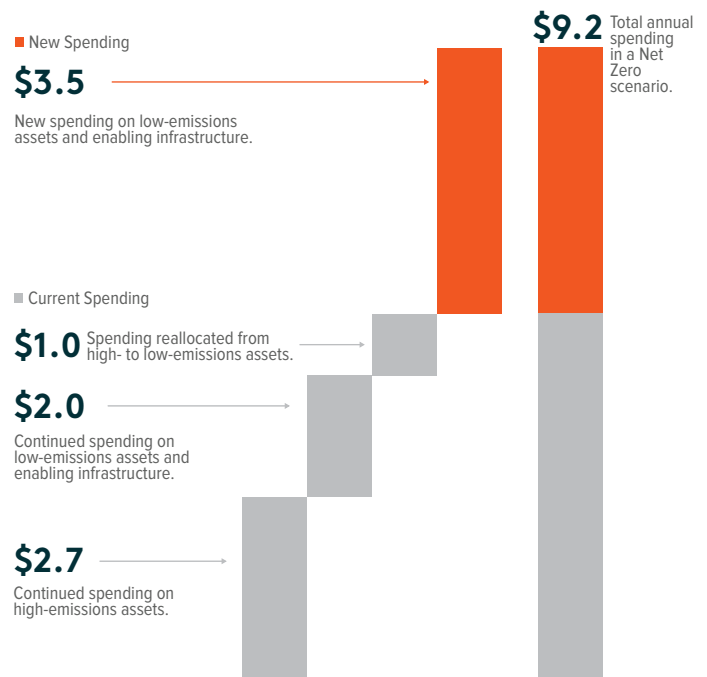
GLOBAL INFRASTRUCTURE INVESTMENT BY SECTOR

Source: Global Infrastructure Hub data as of December 31, 2021



CONSIDERING LEGACY ASSETS/INFRASTRUCTURE COULD DOUBLE COST

Net Zero costs could reach \$9tn a year average (\$275tn cumulative to 2050) when considering legacy assets and reallocating capital per McKinsey.
Source: McKinsey data as of December 31, 2021





Green infrastructure is also a focus for private investors, which is good news because private investment is essential for the future of infrastructure development and to help close the gap. In 2021, global private investment was greener than ever with a 60% share.¹⁸ The renewable energy sector, with a heavy emphasis on solar and wind, continues to attract the most investment, tallying almost half of the total. Investment in battery storage skyrocketed, almost quadrupling from 2020. Encouragingly, the increase in green investment in 2021 was mostly outside renewable energy, such as waste, which historically has not been the case and these areas are in dire need of investment.¹⁹

The trend toward green investments was consistent across all income groups, with the higher income levels having higher percentages. However, the sectors that attracted the most investment by region varied. Within developing areas such as Latin America, Africa, and Oceania, the transport sector garnered much of the investment, in line with the regions' investment needs and gaps.²⁰ Renewables received a large portion of the investment within developed nations.

RISKS TO THE INFRASTRUCTURE DEVELOPMENT THEME

Capital needs are high and projects may take longer than expected.

Infrastructure projects are costly and rely heavily on government sponsorships. The IJJA is a massive step for the U.S., but the future of infrastructure will require much more funding. Elevated global inflation will likely impede the ability to raise more capital as fiscal spending becomes harder.

Moving infrastructure funds from federal coffers to state and then local governments is time-consuming, and construction projects are seldom known for their brevity. Infrastructure investing can be perceived as riskier because the timeline is longer, projects are unclear, and the costs tend to be higher. Between pandemic-related worker shortages and construction delays, rising geopolitical tensions, and growing macroeconomic uncertainty, hundreds of projects have been sidelined. These setbacks could increase the cost of the various projects.

While the total number of announced projects suggest that 2021 was a record year for new solar and wind projects, setbacks kept many announced projects from getting under way as quickly as anticipated. Just 47 (3.8%) of the 1,232 solar and wind projects announced in 2020 are complete. Likewise, only 89 (8.3%) of the 1,069 solar and wind projects announced in 2019 are complete.²¹

Developing countries require significant investment and will likely rely on private investment.

The investment gap between high-income and middle- and low-income widened in 2021. Private investment in infrastructure projects continued to grow in high-income countries, where 80% of all private infrastructure investment occurred. Conversely, private investment continued to trend lower in middle- and low-income countries. The declining trend in infrastructure investment for these countries began before the pandemic, but the crisis exacerbated it.²²

This trend is particularly worrying because the infrastructure need is the greatest in these countries and they have the largest financing gaps. Almost two-thirds of the world's infrastructure needs to 2035 are in emerging economies.²³ Not only do many of these countries lack the basic infrastructure to support economic growth and development, but they are also the ones most vulnerable to the adverse impacts of climate change.²⁴

Heightened political risk and a lack of adequate mechanisms to mitigate financial risk, including exchange rate risk, can be barriers to investment in these markets. As the global economic backdrop continues to wane, the hurdle rates for these investments will continue to climb, further widening the gap.

Labor shortages can be a challenge.

Government and private sector leaders ranked talent and expertise shortages as one of the biggest obstacles to implementing infrastructure projects over the next three years.²⁵ In April 2022, the U.S. construction industry had roughly 440,000 job openings and the U.S. manufacturing industry had over 1 million. And the IJJA is expected to create hundreds of thousands of additional jobs over the next decade.²⁶ These labor shortages can have severe economic ramifications, as any delay across the supply chain can lead to delays in project completions and increase costs. It will be essential to close the widening gap between labor demand and supply in order to minimize these potential negative consequences.

THEMATIC INTERSECTION WITH INFRASTRUCTURE DEVELOPMENT

Connectivity

The pandemic accelerated consumer appetite for ease, convenience, and connectivity. For example, 80% of American workers now expect to work from home at least 3 days a week, compared to the 6% of workers who primarily worked from home prior to the pandemic.²⁷ This transition significantly expands the importance and use of big data. The total amount of data created, captured, copied, and consumed globally is forecast to increase exponentially with big data becoming a \$100 billion market by 2027.²⁸

To support this rapid growth, digital infrastructure will need to create more capacity. It is estimated to grow at a compound annual growth rate (CAGR) of 19.2% from 2020 to 2025.²⁹ The IJJA allocated \$65 billion to communication.³⁰ With more investment to build capacity, communication infrastructure owners and operators should be able to service more customers.

E-Commerce

Shopping on a mobile device is now more accessible and the preferred method of purchase for many consumers, a byproduct of the pandemic shifting life online. In 2020, U.S. e-commerce sales increased 42.4% year-over-year (YoY) to \$811.6 billion. In 2021, the trend continued, as U.S. e-commerce sales increased 14.2% YoY to \$959.9 billion.³¹ These figures make the e-commerce sales of \$199.3 billion in 2011 seem tiny, and they illustrate this segment's rapid growth.

The runway for additional e-commerce sales growth is significant, as e-commerce represented only 13.2% of total U.S. retail sales in 2021.³² Globally, the picture looks the same, with e-commerce sales rising 17.1% in 2021, representing only about 19% of total retail sales.³³ As consumers continue to shop online and demand quick delivery, the need for investment in the infrastructure systems that support e-commerce, such as roads and bridges, will likely grow.

Electric Vehicles

The appetite for electric vehicles (EV) surged in recent years, and sales numbers in 2022 reflect this appetite. During Q2 2022, EV sales in the U.S. jumped to over 440,000, a nearly 13% YoY increase.³⁴ A recent survey revealed that 7 out of 10 U.S. drivers would be interested in buying an EV when charging infrastructure expands and EV costs drop.³⁵ The number of public charging stations in the geographically expansive U.S. has more than tripled since 2015, but it has a long way to go.³⁶ By one estimate, the U.S. needs 20 times more public charging stations than it has today.³⁷

Europe continues to be a global frontrunner in EVs. In 2021, the continent already had about 375,000 charging stations, but even in one analysis' most conservative scenario, the EU-27 will need at least 3.4 million operational public charging points by 2030. Extensive utility grid upgrades are required to increase Europe's renewable energy capacity and to distribute electricity to these new charging stations. In all, the buildout of EV charging infrastructure may cost €240 billion by 2030.³⁸

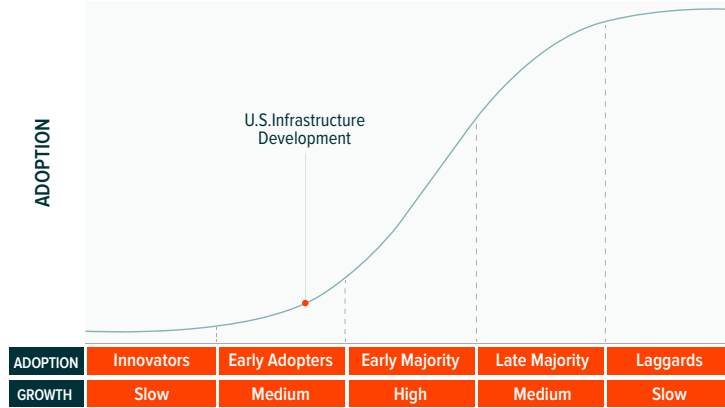


INFRASTRUCTURE DEVELOPMENT IN A PORTFOLIO CONTEXT

The future of infrastructure is dynamic, spanning various industries and themes. On the adoption curve, U.S. Infrastructure sits in the Early Adopters phase. As investments toward improving the infrastructure continue to be prioritized over the next decade, we expect adoption to accelerate.

THEMATIC ADOPTION

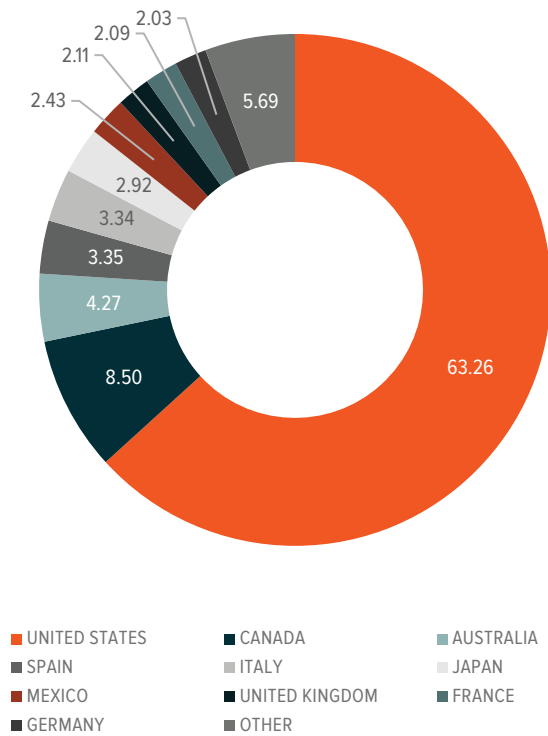
Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.



The pie chart breaks down the geographic exposure of the largest Infrastructure Development thematic ETF products. We believe that there is ample innovation occurring outside the U.S., and that limiting exposure to the U.S. could exclude key players to the detriment of investors over the long term.

INFRASTRUCTURE DEVELOPMENT: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of October 31, 2022



In our view, thematic equity should be targeted, using screens to ensure that the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between Infrastructure Development ETFs, the S&P 500, MSCI ACWI and the most applicable S&P 500 sector ETF, the Industrial Sector SPDR Fund (XLI). We found that average overlap by weight was 3.7% when compared to the S&P 500, 3.0% vs. the MSCI ACWI, 6.7% vs. XLI.³⁹ The low overlap with broad indexes reflects the benefits of thematic exposure, as sector indexes have yet to include substantial exposures towards the Infrastructure Development theme.

Accelerating infrastructure investment is crucial over the next decade. The American Society of Civil Engineers estimates that the U.S. needs to invest over \$2 trillion by 2025 to address critical deficiencies in the nation's roads, railroads, waterways, water systems, dams, airports, electrical grids, waste management systems, park systems and educational infrastructure. Failure to repair and update these systems by 2025 could result in nearly \$4 trillion in lost GDP, \$7 trillion in lost business revenue, and 2.5 million lost jobs.⁴⁰ Globally, the lack of investment to fix deficiencies would be exponentially worse.

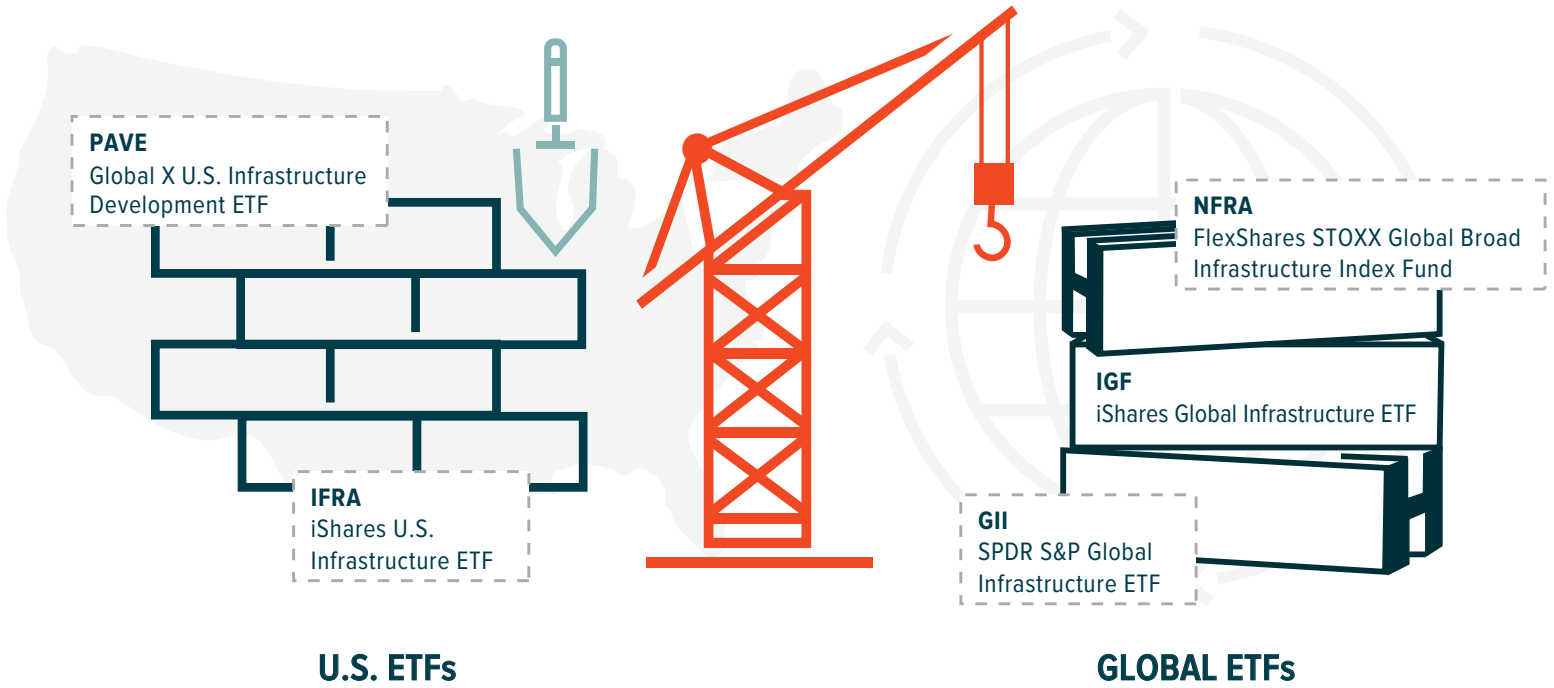
Infrastructure Development may not seem as dynamic as other themes, but it is the means by which people and economies connect on local, national, and international levels. And it can't be ignored any longer. After decades of underfunding, urgent enhancements, overhauls, and innovation are needed. Aside from normal wear and tear, in its current state, the world's infrastructure is not equipped to withstand the impact of climate change.

We expect public and private sector investment will continue to increase, both in size and scope, to address these needs. Emerging from these investments are likely to be compelling investment opportunities, exposure to which can provide portfolios meaningful return potential.



HOW TO ACCESS INFRASTRUCTURE DEVELOPMENT

The graphic below identifies the largest U.S. listed ETFs that provide direct exposure to the Infrastructure Development theme.





INFRASTRUCTURE DEVELOPMENT FOOTNOTES

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- ³ Global X Research, Congress Passed the Infrastructure Investment & Jobs Act. What Does This Mean for Investors?, November 21, 2021.
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- ¹³ ASCE 2021 Infrastructure Report Card, Report Card for America's Infrastructure, 2021.
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- ¹⁵ electrek, Renewables provided over 25% of total US electrical generation in first half of 2022, August 25, 2022.
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- ¹⁷ Refinitiv, Potholes on the road to sustainable infrastructure, December 2022.
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- ²⁸ Cybernews, Here's the most desirable data science job position, October 4, 2022.
- ²⁹ Statista, Volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2020, with forecasts from 2021 to 2025, September 8, 2022.
- ³⁰ Global X Research, Congress Passed the Infrastructure Investment & Jobs Act. What Does This Mean for Investors?, November 21, 2021.
- ³¹ Digital Commerce 360, US ecommerce in 2022 tops \$1 trillion for first time, February 17, 2023
- ³² Oberlo, US Ecommerce Sales (2012-2022), December 2022.
- ³³ Statista, E-commerce as percentage of total retail sales worldwide from 2015 to 2021, with forecasts from 2022 to 2026, November 25, 2022.
- ³⁴ Kelley Blue Book, Electrified Light-Vehicle Sales Report Q2 2022, July 13, 2022
- ³⁵ Consumer Reports, New Consumer Reports Survey Finds Majority of Drivers are Interested in Electric Vehicles, December 17, 2020
- ³⁶ MIT Tech Review, The U.S. only has 6,000 fast charging stations for EVs. Here's where they all are, June 28, 2022
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- ³⁸ McKinsey & Company, Europe's EV opportunity- and the charging infrastructure needed to meet it, November 4, 2022.
- ³⁹ ETF Action data as of November 18, 2022. Overlap data focuses on the largest five U.S. listed ETFs for the theme.
- ⁴⁰ Forbes, The Future is Physical: Infrastructure is Tomorrow's Most Important Technology, May 29, 2018.

Investing involves risk, including the possible loss of principal. Narrowly focused investments may be subject to higher volatility. Technology-themed investments may be subject to rapid changes in technology, intense competition, rapid obsolescence of products and services, loss of intellectual property protections, evolving industry standards and frequent new product productions, and changes in business cycles and government regulation.

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